Ultrafast Coherent Manipulation of Condensed Phase Quantum Systems

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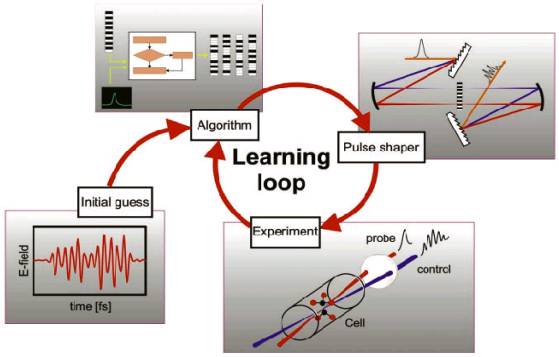

•Ultrafast optical pulse shaping techniques combined with adaptive feedback can selectively excite materials with the goal of reaching unusual non-equilibrium states.
•Coherent control arises from the cooperative interaction of the pulse's tailored field and the evolving wavepacket such that the resulting state is sensitive to the pulse's structure.

•Objective: ***The development of the field of coherent control of solid-state systems using shaped optical pulses for the preparation, manipulation, and interrogation of quantum wavepackets.***

–Application to quantum technologies

–Enhancement of optoelectronic properties of materials

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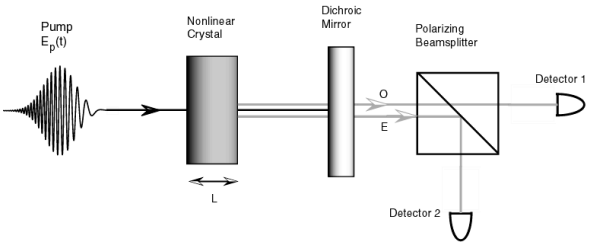
Coherent control of quantum states of light using parametric downconversion



•The ability to tailor the optical pump pulse will enable control over the quantum state of the photon pairs generated in PDC.
•Investigate the effect of the shape of the input electric field on the character of the two-photon down-converted states.
•Optimize a single photon source (containing at most one quantum).
•Explore new areas of quantum entanglement
  •Interplay between time and frequency coincidence
  •Hyperentanglement
  •Manipulation of photon-photon coherence properties

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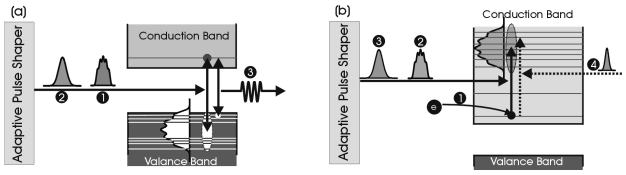
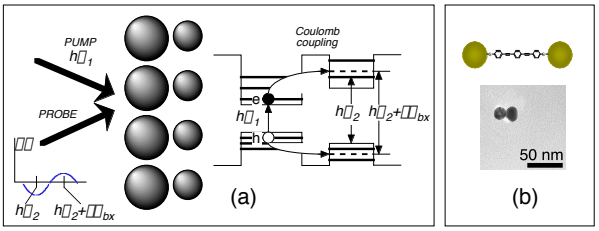
Presenter: Toni Taylor

Colloidal quantum dots and quantum information processing



Coherent manipulation of NQD states:
Coherent "Rydberg" wavepackets, quantum interference, and decoherence. Use interband transitions in using holes in valence band and intraband transitions of doped electrons in conduction band.



Quantum dot molecules and quantum logic operations:
1) Optimize exciton-exciton interaction that provides the coupling needed for entanglement in NQD bilayers
2) Entangled states will be studied and manipulated on isolated dimers

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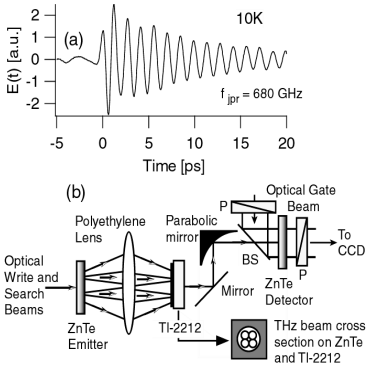
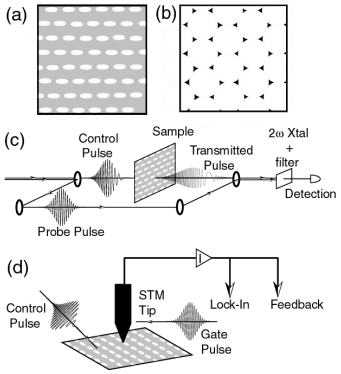
Coherent control and information processing in bulk condensed phase systems



Manipulation of collective excitations in solids for data processing

•Optically encode data onto a collective response.
•Follow by a read or search process.
•Josephson plasma resonance in Tl-2212.



Energy localization in solids

•Develop the ability to address a specific site in a nanostructure
•Coherent control of excitation of surface plasmons on a nm scale.
•Far field, and ultimately, near field experiments

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